LOGGING INDUSTRY RESEARCH ORGANISATION
NEW ZEALAND

ISSN 0111-6711

REPORT

Vol. 17 No. 6 1992

LONG TERM DATA COLLECTION TO BENEFIT CONTRACTOR RECORD KEEPING

Tony Evanson

ABSTRACT

A shift level availability and productivity (SLAP) study was introduced and data was collected over 200 days on a Caterpillar D4H cable tracked skidder working in Kinleith Forest. Analysis of 22 days of this shift level data from one setting showed, for a mean extracted piece size of 1.7 tonnes, estimated hourly productivity was 25.2 tonnes per productive machine hour. The average haul distance for the 6.7 ha setting was 223 metres and mean haul size was 7.1 tonnes.

A time study-based evaluation was also carried out to verify the shift level derived estimates for the above setting. Time study data analysis showed for downhill hauling over an average haul distance of 177 metres, an average productivity rate of 22.5m^3/productive machine hour with a mean extracted piece size of 1.3m^3 and a mean haul size of 6.0m^3.

This study demonstrated that long term data collection can provide a reliable estimate of hourly production and can provide the contractor with much useful information.

INTRODUCTION

A system for collecting long term productivity information has been developed for both logging planning purposes and as a production record keeping tool for contractors.

This method, known as shift level availability and productivity (SLAP) studies, has been used extensively by FERIC in Canada and by researchers in the United States to complement time study derived information (Cottell et al, 1969; Curtis, 1978; Folkema et al, 1981; Krag et al, 1987). This data collection method was used for two years in New Zealand to collect data from six cable haulers (Evanson and Kimberley, 1992 (in prep.)

Shift level data from cable logging operations has provided reliable estimates of productivity. In one example, shift level summaries of delays and output by a hauler operator provided average production rates within 2% of stopwatch results. (Olsen and Kellogg, 1983).

The objective of this Report is to demonstrate the use of a long term data collection system modified to apply to a cable tracked skidder operation.

ACKNOWLEDGEMENTS

LIRO acknowledges the co-operation of Archie Moffat, his logging crew and the staff of NZFP Forests Limited for their assistance with this study.

TIME STUDY versus LONG TERM DATA COLLECTION

Time Study

The most commonly used method for collecting productivity information on harvesting equipment is the time study or stopwatch production study. Typically, time studies are used to obtain a "snap shot" view of the production capacity of the operation which may cover from one to five days and involves detailed time measurement of defined activities in the work cycle. A very accurate assessment of the productivity of the machine studied can be made for the study period. Predictive equations can be derived to assess likely productive capacity under various circumstances.

Conventional time study, while serving to increase the understanding of a particular machine's operating ability, does have some drawbacks. These can limit the value to contractors of the information produced. Some of these disadvantages include :

Variation

Working conditions can vary on a daily basis and many factors affect the productivity of an operation, such as wet weather, mechanical breakdowns, tree size, adverse slopes, extraction distances and operator motivation. Also some work activities such as tracking or maintenance may occur outside of normal work hours, and go unrecorded by time studies. The researcher tries to study operations only in normal conditions and thus avoids extremes.

It may be that the terrain, tree size and operating conditions on the days chosen for a study are unrepresentative of the "average" conditions for that operation. This variation means that daily or hourly production values derived from time studies must be viewed critically by the contractor.

Absence of trend information

Time study does not reveal any production trends within an operation. A contractor needs to be aware if production is changing with time and what factors are likely to be responsible for this change.

Limited contractor involvement

The contractor does not participate in the learning process that can occur as the features of the operation are measured. The contractor usually has little involvement with the analysis, write-up and distribution of results.

Choice of operation studied

Time studies are expensive, therefore the research organisation is selective about which operations to investigate. It is unlikely to undertake a study solely because an individual contractor wishes to gain a better understanding of the productivity variations within his own operation.

In spite of its deficiencies, time study is a useful tool for obtaining quick and detailed information on an operation and will continue to be used by researchers.

Long Term Data Collection

Long term data collection is operational and production information collected by contractors on a daily basis over the long term. This data can be combined with data from company weighbridges and stand records to provide operational summaries on a monthly or setting basis.

Information derived on this basis can answer many of the questions that conventional time study cannot. Long term production data has several advantages for the contractor, which include :

Confidence in the data

Because the contractor is closely involved with the collection of the data he can relate easily to the results. For instance, the operating conditions prevailing on a particular day can be noted, and may explain changes in production. It follows that the data collected is of most value if it has been collected conscientiously.

Performance monitoring

Detailed records of daily production can enable a contractor, who may own or operate several crews, to compare performance over time or by location. A comparison may reveal a management deficiency or indicate the effect of extracted piece size or terrain type. For instance, a change in piece size may require the contractor to increase his daily goal of trees extracted to maintain cash flow.

Costing

Detailed long term records of time worked, utilisation of equipment or repair and maintenance time can provide a basis for a more reliable costing of an operation than the use of factors or "average" values. Only the large equipment owning companies have access to this kind of data and contractors usually have to use other values in the absence of more specific ones from their own operation.

Timely information

The contractor has immediate recourse to his data. Like a diary, conscientiously kept records can provide an immediate answer to what happened last week or last month. This is particularly useful when investigating reasons for poor financial performance.

Co-operation with researchers

At present long term data entered into a LIRO database is available to participating contractors. Data can be summarised or analysed by whatever factor or time period desired. Contractors can choose or request the kind of analysis that they believe will benefit their operation. If desired, results can be kept confidential.

Focus on critical areas

The act of record keeping can lead to a contractor having a more objective view of his business. This can allow him to focus on the conditions or areas critical to business success. Critical conditions may include mean haul size, extracted piece size, haul distance, topography or the use of time on the job

LONG TERM DATA COLLECTION METHOD

Around 2000 days of production data has been collected by LIRO in the past three years. This includes 1200 days (64 settings) on cable haulers including the Madill 071, Ecologger 2, Lotus 4 and Bellis haulers.

Data on ground based systems has included the Caterpillar D6, D5H, 518 skidder and D4 cable tracked skidder. Thirteen contractors have participated in this collection system, including two contractors overseas.

Daily production and operating condition data is recorded by the contractor on a form supplied by LIRO (Figure 1). Once a month these forms are sent to, or collected by, LIRO staff. Companies supply weighbridge and stand data, such as total tonnes per setting or landing and a stand map. The map is used to measure average haul distances and areas, and weighbridge data is used to calculate a mean extracted piece size.

Logging crew name :

Date : | Time arrive : | Time depart :

	Number of		Side slope at breakout				Tracking (if more than 3 min.) duration
	Logs	Pieces	Flat	Undul	Steep	V. steep	
			Pull rope : U = uphill D = downhill				
1							
2							
3							
4							
5							Mechanical delays, (include in-shift maintenance). Cause and duration. (For repairs see back of booklet)
6							
7							
8							
9							
10							
11							
12							Other operational and social delays. Cause and duration
13							
14							
15							
16							
17							
18							Out of shift R and M. Cause and duration (For repairs see back of booklet)
19							
20							
21							
22							
23							
24							Out of shift tracking (if more than 3 minutes)
25							
26							
27							
28							
29							
30							Pulling arch yes / no

Weather : am - wet/dry pm - wet/dry | Pulling : uphill / downhill

Pulling : on contour track / off track | Strops : 1 2 3 4 5 6

Figure 1 - Long term data collection form

The raw data is entered into a computer and summary reports generated which are sent to the contributing contractor promptly. Reports are by month or by "setting" or landing and include a production summary, comprising estimates of average extracted piece size, haul size, hauls per day, and productive cycle time. A summary of daily time use is also prepared including total time spent on activities such as tracking, repair and maintenance and other delays.

Periodically, when sufficient data is available, a comprehensive analysis can be made of the summarised data (Evanson and Kimberley, 1992 in prep.). Results of such analyses are published and are available to the participating contractors.

In order to test or "audit" the estimates derived from the long term data, detailed time study data is periodically collected and a comparison made between estimates of productivity for a defined time period or area.

AN EXAMPLE OF THE METHOD

Long Term Study : Block 7315 Settings 10, 13, 14, 16.

A total of 108 days' data was collected from Block 7315 in Kinleith Forest. The data was summarised by block or group of settings and by setting. Data collected by the operator included time spent tracking, operational delays of longer duration than three minutes and counts of numbers of logs and pieces by haul cycle. In order to describe the terrain and operating method, the operator was also asked to record, in his opinion, class of sideslope at breakout, eg. "steep" or "undulating", and extraction direction, eg. "uphill, on track".

NZFP Forests Limited staff supplied stand data, maps and weighbridge summaries by month, setting and landing. The daily record forms were collected by the supervisor and sent with maps and weighbridge figures to LIRO for entry into a database and subsequent summary.

Weighbridge data, obtained at the completion of the setting, was used to calculate a mean extracted piece size value. This was done by dividing the total weighbridge tonnes uplifted from the setting by the total number of pieces recorded by the contractor.

Time Study : Block 7315 Setting 16

A continuous time study of 69 cycles of downhill extraction was undertaken in Block 7315 in Kinleith Forest (Table 1).

Data collection included times for cleaning up the skid site (fleeting) and tracking (blading). Operational delays, such as loader interference were included. The length, large end diameter, diameter at 15 metres and small end diameter of each tree extracted during the study, the number of tree lengths per cycle, travel empty and travel loaded times were recorded.

Mean Stocking (stems/ha)	477
Upper slope (stems/ha)	725
Mean Diameter (cm)	37
Mean Height (metres)	40
Stand Age (years)	30
Slopes (degrees):	
Breakout Sites - maximum	34 (67%)
Return Track - maximum	26 (50%)
Slope Shape	Slightly Concave
Slope Length	150m (est)

Table 1 - Stand details

RESULTS OF COMPARISON OF THE TWO METHODS

From data collection over 22 days in Block 7315, Setting 16, a productivity level of 25.2 tonnes/productive machine hours (PMH) was calculated. Mean haul size was 7.1 tonnes for an average extracted piece size of 1.7 tonnes.

A time study (in the same setting) in downhill extraction of 1.3m^3 mean extracted piece size, revealed an average productivity rate of 22.5m^3/PMH. With a mean 6.0m^3 haul size this rate translates to a daily production rate of 161m^3.

The main factors affecting productivity as studied were the haul distance travelled and the haul size. Travel empty time was found to be not sensitive to distance, possibly because other factors such as track slope were also important. Travel empty time took an average 23% of the productive cycle time and mean travel empty distance was 30% greater than the mean travel loaded distance.

The average hourly productivity estimate from 22 days' data collection was 12% higher than time study derived value (a 1 tonne/m^3 conversion factor was assumed). Two reasons for this disparity are; the inherent variation in production over time, and the difference in extracted piece size for the two studies. The three day time study captured data at the lower end of the production range for this crew. The time study took place while the crew were working upper unthinned slopes. An average productive cycle time estimate from 22 days' data collection was only 6% higher than the time study derived value (Table 2).

	Time study (7315/16)	*Shift level (7315/16)*	*Shift level (Overall data)*
Time period	3 days	22 days	108 days
Area (ha)		6.7	35.7
Tracking (hrs. in shift)		1.3	6.1
Tracking (hrs. out of shift)		4.9	10.3
Average values			
Total productive Cycle time (min)	15.9	16.8	16.7
Trees/cycle	4.6	4.1	4.2
Mean extracted piece size	$1.3m^3$	1.7 tonnes	1.5 tonnes
Haul volume (m^3)	$6.0m^3$	7.1 tonnes	6.5 tonnes
Distance loaded (m)	177	223	185
Delay-free production per hour	$22.5m^3$	25.2 tonnes	23.2 tonnes
Daily production	$161m^3$	198 tonnes	173 tonnes
Utilisation (%)	83	87	86
Scheduled hours	8.6	9.0	8.6

Table 2 - Comparison of time study and long term derived estimates

	SETTING			
	# 10	# 13	# 14	# 16
Sideslope : % occurrence				
Flat	5	8	3	22
Undulating	21	9	21	15
Steep	65	79	75	50
Very Steep	9	4	1	13
Extracted piece size (tonnes)	1.6	1.2	1.6	1.7
Production tonnes/PMH	24	18	25	25

Table 3 - Terrain and productivity variation in Block 7315, Kinleith Forest

Table 3 shows terrain description data for four settings and illustrates the range of terrain encountered, and extraction methods used, over 108 days logging. The effect on productivity of extracted piece size is evident. Setting 13 shows a higher percentage of steep slopes and correspondingly less undulating slopes and these factors may have influenced productivity in this setting. However, the effect of extracted piece size may be a stronger one than percentage of steep terrain.

CONCLUSIONS

The results from the long term data and associated "audit" by time study demonstrate that long term data can provide a reliable estimate of hourly productivity and an estimate of productive cycle time. A precise estimate of extracted piece size, (weighbridge tonnes obtained by dividing by the total number of pieces extracted) is obtained by long term data collection. The time study is a short duration sample of the total range of daily production of the operation and produces estimates that are reliant on conditions at the time of the study.

There was a 6% difference in total productive cycle time between the time study and the long term data. An average hourly productivity estimate from the 22 days of production data was 12% higher than time study derived value.

Long term data collection systems are easy for the contractor to use and provide useful data. Given that an accurate piece count is maintained, and weighbridge figures reflect the tonnage uplifted from a setting, analysis of the data can supply a useful mean extracted piece size value. In turn, a mean daily production value for the setting and associated conditions is derived.

For the contractor, long term data can give a record of system performance for a given setting, providing information on production and time usage. This information can be used to plan future operations where terrain and crop characteristics are known, and point to possible efficiencies through more productive use of time.

REFERENCES

Cottell, P.L. and Winer, H.I. (1969) : "Alternative Methods for Evaluating the Productivity of Logging Operations : Implications of a Study of Wheeled Skidding." Woodlands Papers, W.P. No.14. Pulp and Paper Research Institute of Canada.

Curtis, Richard James. (1978) : "Production Rates of Skyline, Balloon, and Helicopter Yarding Systems from Gross Time Study Analysis." Thesis (M.F.). Oregon State University.

Evanson A.W and Kimberley, M. (1992) : "An Analysis of Shift Level Data from Six Cable Hauler Operations. Bulletin (in process). Forest Research Institute.

Folkema, M.P., Giguere, P. and Heidersdorf, E. (1981) : "Shift Level Availability and Productivity : Revised Manual for Collecting and Reporting Field Data." Forest Engineering Research Institute of Canada.

Krag, R.K., Webb, S.R. (1987) : "Cariboo Lake Logging Trials : A Study of Three Harvesting Systems on Steep Slopes in the Central Interior of British Columbia." Technical Report TR 76. Forest Engineering Research Institute of Canada.

Olsen, E. D. and Kellogg, L. D. (1983) : "Comparison of Time-Study Techniques for Evaluating Logging Production." Transactions of the ASAE V. 26, No. 6. pp. 1665-1668, 1672.

For further information, contact:

LOGGING INDUSTRY RESEARCH ORGANISATION
P.O. Box 147,
ROTORUA, NEW ZEALAND.

Fax: 0 7 346-2886 *Telephone: 0 7 348-7168*